T0051-P Non-Invasive Hemodynamic Monitoring in Microgravity

Problem Statement

- Hemodynamic monitoring is of prime importance for assessing cardiovascular changes due to fluid shifts and reduced loading in space. Current technologies (echocardiography, ICG) remain complex for routine use. Therefore, a ballistocardiography (BCG)-based system is being developed.
- The BCG system is suited for both terrestrial and space use. Testing in reduced gravity will provide vital information to relate future micro-gravity measurements to existing ground studies.
- NASA, for preventive monitoring, and titration of counter-measures in space. Healthcare providers, for ground-based non-invasive hemodynamic monitoring.

Technology Development Team

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Support: Self-funded, with support from Stanford University.

Proposed Flight Experiment

Experiment Readiness:

- 09/27/2012

Test Vehicles:

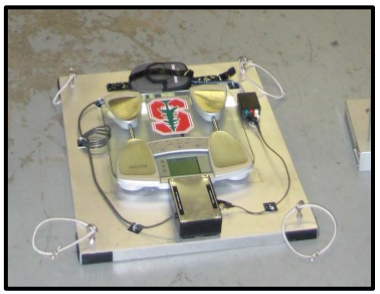
- Parabolic aircraft

Test Environment:

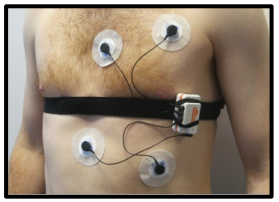
- Experiment will require microgravity (0g) environment.

Test Apparatus Description:

- The BCG system is composed of a weighing scale and accelerometer (for noise cancellation) attached to the airframe. A set of electrodes and an accelerometer is attached to the test subject to record the electrocardiogram (ECG) and the acceleration BCG. Data will be streamed to a laptop for visualization, as well as logged locally.
- Measurements will be taken with the test subjects tethered to the scale, as well as free-floating.



Scale on its base, with signal conditioning electronics.



Shimmer data logger & ECG (accelerometer not shown. ECG may be separate).

Technology Maturation

This flight campaign is expected to lead to the following maturation steps:

- Successful recording of scale-based BCG in microgravity.
- Successful collection of ground and microgravity BCG measurements on the same device.
- Validation of the relationship between ground-based and microgravity-based measurements.

A new device at TRL 6 could be validated in a 2013 flight campaign.

Objective of Proposed Experiment

- Demonstrate scale-based BCG recordings in microgravity.
- Refine noise-cancellation algorithms for high-quality BCG recording in microgravity.
- Gather BCG measurements in 1 and 0g using the same device, allowing interpretation of micro-gravity data in light of ground studies.
- Collect free-floating acceleration BCG data, for comparison with existing microgravity BCG data.

Applicable to TA-06 (Human Health, Life Support & Habitation Systems) - Human Health and Performance

6/2012